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Intensive agriculture,climate change,urbanization,pollution, soil erosion,climate change etc. have degraded 33% of land resources globally. In India, about 50% of the geographical area is degraded.The present fragile situation of earth warrants an urgent need to formulate a national soil writes Deepranjan Sarkar and associates. Moreover, the COVID-19 pandemic has forced agriculture to create livelihood opportunities for millions of migrated workers. Its high time we integrated food production practices with land management practices to promote the principles of sustainable agriculture and attain our targets (regional, national, and global) by the year 2030.

Rakesh and associates describes in detail about the Carbon Sequestration for Land Restoration towards Climate Mitigation and Global Food Security. The article is a reminder that Progressive increase in atmospheric greenhouse gases (GHG) are restricting the sunlight from reflection and being responsible for earth's temperature increase. Carbondioxide (CO2) is the dominant GHG among other gases such as methane (CH4), hydrofluorocarbons (HFCs), carbon monoxide (CO) etc., playing a key role in climate change.

Manju Kumari and associates details about the indiscriminate use of poor quality water that degrades the soil quality and crop productivity due to accumulation of salts and deterioration of soil physico-chemical and microbiological properties. For sustaining the crop production in these soils, salt concentration in root zone should be maintained below the permissible limits. B.C.Shetty of Kadike Trust explains the Revival Efforts through 'Save Udupi Saree 'Campaign keeping Talipady weavers society as base, there were only eight weavers in this society.

Over the past few decades, Remote Sensing (RS) and Geographical Information System (GIS) have played an important role in many sectors for visualization,monitoring, management and potential development. These technologies help us to get reliable information of natural and man-made phenomena occurring over the earths surface without making any physical contact writes Kamalakar and associates. Shikha and associates explains the Agricultural Technologies for Sustaining Soil Health systems in Hilly Agroecosystems in Uttarakhand. The organic carbon status of the Tehri Garhwal region is high which ranges from 0.58% to 1.98% with an average of 1.28% (high) because farmers use only FYM, vermicompost and crop residues in their field.

Pavitra and Dr Mini recognises the health attributes of exotic fruits like dragon fruit and its vast scope in Value addition in their article. Vinod Kumar Bisht writes about utilising the saline lands for shrimp farming that could be a game changer not only for the farmers but also for the country as it is a high value commodity and also has a high export value.

The Special Issue of Agriculture World July focusses on Soil Health and Ecosystem Regeneration and throws light on different aspects on how degradation could raise pandemics and also how to tackle them effectively.

MC Dominic
Editor-in-Chief

DR. LAKSHMI UNNITHAN
From the Editors Desk

The Diverse Challenges and Constraints of natural resource degradation, climate change, shifts in land use patterns, increasing desertification, decreasing soil productivity all demand a paradigm shift in formulating and implementing the agricultural programmes in India. Adaptive Soil management practices are definitely to be given priority to achieve Sustainable Agriculture.

Strategies and Technological interventions need to focus on reclaiming Soil Health and Ecosystems. A decline in soil structure, biodiversity and quality leads to degraded and fragile agroecosystems. Indiscriminate use of chemicals (skewed N:P:K ratio) and burning of crop residues are degrading Indian soil and jeopardizing the health of its citizens badly.

Resource management in farming systems is an interlinked concept covering soil, nutrient, water, crop, forest, livestock and fishery management practices. Agriculture World–July issue focusses on Soil Health and its components that constitute the agricultural ecosystems. Join us in our journey towards dissemination of news which will help boost economic growth in an agrarian country.

Land Restoration During the UN Decade on Ecosystem Restoration

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Background

Land use practices like intensive agriculture, deforestation, industrialization, urbanization, groundwater extraction and exploitation, etc., and several land use induced processes like salinization, alkalinization, desertification, acidification, pollution, accelerated soil erosion, climate change, etc. have degraded over 33% of land resources globally. In India, about 50% of the geographical area is degraded.

As per the estimation of the National Bureau of Soil Survey and Land Use Planning (NBSS&LUP, 2004), in India, around 147 million hectares (Mha) of the land area is degraded. Climate change driven by increasing greenhouse gas emissions is being a key factor in land and ecosystem degradation. Climate vagaries such as cyclones, floods, droughts, etc., are devasting agricultural lands for centuries and resulting in a huge loss of economy in India.

Thus, the productive capacity and ecosystem services of land decrease temporarily or permanently. A decline in soil fertility, structure, biodiversity, or quality leads to degraded and fragile agroecosystems. Indiscriminate use of chemicals (skewed N:P:K ratio) and burning of crop residues are degrading Indian soil and jeopardizing the health of its citizens badly. The present fragile situation warrants an urgent need to formulate a national soil protection policy and pay farmers for ecosystem sevices. Moreover, the COVID-19 pandemic has forced agriculture to create livelihood opportunities for millions of migrated workers and lessen the socio-economic challenges of India.

Land degradation neutrality for achieving sustainable development goals

Land restoration is a part of agroecosystem restoration. Agroecosystem restoration can help to achieve the Sustainable Development Goals (SDGs) of the United Nations (UN). SDG target 15.3 states: "By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought, and floods, and strive to achieve a land degradation-neutral world." Country parties reached a breakthrough agreement to approve the vision of land degradation neutrality (LDN) and link the implementation of the Convention to the SDGs in general, and target 15.3 in particular at the 12th session of the Conference of Parties (COP) of the United Nations Convention to Combat Desertification (UNCCD) held in 2015 in Turkey. Thus, target 15.3 has become a strong vehicle for driving UNCCD implementation, while achieving the multiple SDGs, such as biodiversity conservation, food and water security, disaster risk reduction, climate change mitigation and adaptation, and poverty reduction.

SDG target 15.3 along with many SDGs can be addressed by the LDN as it is synergistic, cost-effective, and in accordance with countries' specific national contexts and development priorities. These targets also help in strengthening of executing the countries' UNCCD National Action Programmes. Therefore, it is high time to integrate food production practices with land management practices to promote the principles of sustainable agriculture and attain our targets (regional, national, and global) by the year 2030. Further, international initiatives like The Bonn Challenge aimed to cover 150 million hectares (Mha) of degraded and deforested landscapes under restoration programmes during the year 2020 and 350 Mha by 2030. India has also pledged to restore its 26 Mha of degraded lands by 2030.

At Conference of Parties (COP) 14, the Hon'ble Prime Minister, Shri Narendra Modi addressed that "India would raise its ambition of the total area that would be restored from its land degradation status, from twenty-one million hectares to twenty-six million hectares between now and 2030"; majorly focusing the restoration of land productivity and ecosystem services of 26 million hectares of already degraded lands. The Paris Climate Agreement on the reduction of climate change to pursue efforts to limit the increase of earth's temperature to 1.5 °C as produced at the 21st Conference of the Parties (COP 21) of the United Nations Framework Convention on Climate Change's (UNFCCC) in Paris, 2015. United Nations Decade on Ecosystem Restoration (2021–2030) has been largely framed to promote protect, and restore the terrestrial ecosystems, protect biodiversity, combat desertification, and sustainably manage the agroecosystems and forest systems.

Restoring the marginal and degraded lands

Adaptive soil management practices are key in land restoration programmes. The decreased productivity in Indian agriculture is often related to a decline in nutrient use efficiency and soil quality. The drivers of such deterioration are mismatch between nutrient demand and supply or negative nutrient balance. Therefore, nutrient management challenges need special attention in sustaining the diverse cropping or farming systems of global agriculture. To feed the burgeoning population, the application of NPK based fertilizers will increase to 35–40 (million tonnes) Mt from the current rate of 30 Mt, and the extra

requisite of 10 Mt nutrients has to be fulfilled from nature-based solutions including organic sources (farmyard manure, crop residues) and microbial resources. Our continuous negligence of micronutrient management in soils has led to widespread micronutrient deficiency of soils. Balanced application of nutrients (macro and micro) improves the crop yield, quality, and resistance to diverse stresses. In alkali soils, the application of zinc is very important but the efficiency is highly related to the degree of soil reclamation using soil amendments like gypsum.

However, the adaptability of soil amendments or conditioners is not only dependent upon efficiency but also on availability and cost-effectiveness. Therefore, it would be better to explore waste management techniques for the sustainable management of soil resources. For example, industrial wastes or byproducts like press mud (sugar industry waste) are used for acid soil reclamation. Currently, customized fertilizers have been developed as a site-specific nutrient management tool to deal with nutrient deficiency. To ensure timely access to chemical fertilizers, we must explore alternative sources of fertilizers like glauconite which can act as a source of potassium fertilizer. In the case of phosphorus fertilizers, phosphatic rocks are the only source,

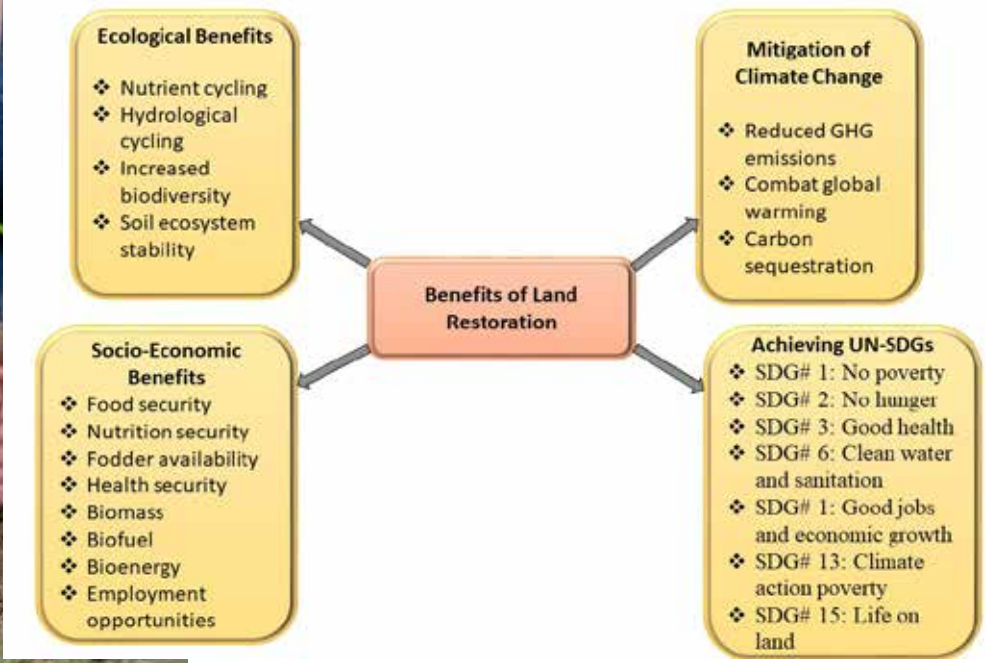

Fig. 1. Land restoration for achieving sustainability in agroecosystems and forest systems

and the present mining rate shows that the global reservoir of phosphorus will shrink in about 100 years or less than that. This compels us to move forward with microbial-mediated nutrient management. Bioinoculants are an integral part of integrated nutrient management which is recognized as a low-input, ecofriendly, and economic option to reduce the requirements of agrochemicals and promote sustainable agriculture. The microbes restore the fertility of degraded lands by producing several organic acids and enzymes and harnessing symbiotic relationships with plants.

Microbial colonization in roots helps to improve root growth. Arbuscular mycorrhiza in association with plants produces a glycoprotein called glomalin that improves soil aggregation. Wide commercial formulations of microbes are available in the market. These include single microbe as well as a microbial consortium. To harness the benefits of microbial resources, farmers should be trained regarding the application, mass production, and commercialization of beneficial microbes. Increasing soil organic carbon (SOC) has been proposed to mitigate climate change with the additional benefit of improving soil structure and conditions. Restoration of SOC content in degraded areas offsets GHG emissions and provides benefits of enhanced soil conditions.

Agroforestry is another option to restore marginal and degraded lands. Here, multipurpose trees like Prosopis juliflora, Gliricidia sepium, Leucaena leucocephala, Acacia nilotica, etc. are planted. These trees are also combined with fodder grasses (kallar) or forage legumes (berseem). Biodiesel plants like Jatropha act as magical plants in wastelands because they help in revitalizing degraded lands, securing energy security, and creating employment opportunities. Crop diversification strategies (intercropping) are adopted to maintain biodiversity, safeguard soil and water quality, and reduce the risk of crop failure. We conclude that land restoration not only guarantees food, nutrition, and health security but also fulfills the UN-SDGs **(Fig. 1)**. Therefore, we must develop a decision support framework to restore our degraded lands by adopting innovative solutions at local, global, and policy levels. Science, technology, and knowledge on land degradation are critical to enabling the participation of stakeholders. Financing and technology transfer is also important to mobilize the targeting and coordination of national, bilateral, and multilateral financial and technological resources to increase the impact of land degradation measures for rehabilitation in India.

CARBON SEQUESTRATION FOR LAND RESTORATION

Climate Mitigation and Global Food Security

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RELATION OF C SEQUESTRATION WITH CLIMATE, SOIL AND FOOD PRODUCTION

Global warming, soil degradation, population growth and hunger are intrinsically linked. Nowadays, climate change impacts are visible globally. Progressive increase in atmospheric greenhouse gases (GHG) are restricting the sunlight from reflection and being responsible for earth's temperature increase. Carbon dioxide (CO_2) is the dominant GHG among other gases such as methane (CH_4), hydrofluorocarbons (HFCs), carbon monoxide (CO) etc., playing a key role in climate change. As a result, we could see the vagaries of weather in the form of floods, droughts, cyclones, heatwaves, storms, irregular rainfall patters etc.

Such change in weather condition devastating the agricultural lands through soil erosion, acidity, salinity, water logged and marshy lands etc. As per Intergovernmental Panel on Climate Change (IPCC) Report, 2015, it is estimated that the concentration of CO_2 in atmosphere has reached to 400 parts per million (ppm) which is unsafe for living entities of earth. However, anthropogenic causes are one of the major reasons for increasing the CO_2 in atmosphere. Industrialization and intensive agriculture are being the major factors; about 22% of global GHG emissions are contributed by agriculture, forestry, and/or other land uses (IPCC, 2019). Cultivation of arable lands resulting into substantial loss of soil organic matter (SOM) and emissions of CO_2 from soil to the atmosphere, thereby increasing the CO_2 concentration in the atmosphere (Ladha et al., 2015).

Intensive tillage, non-judicious use of chemical fertilizers, improved crop protection practices and burning of crop residues are the major practices that contribute to GHG emissions. However, agriculture is not only a contributor of GHG emissions but also helps in achieving climate change mitigation and land restoration. The mitigation potential of agriculture by 2030 was estimated to be about 5.5 to 6.0 Pg CO_2 eq. yr^{-1}, if improved agricultural management practices are adopted globally. Carbon (C) sequestration in terrestrial ecosystems have spurred interest on research community in enhancing the sequestration of atmospheric CO_2 (Sarkar et al., 2020).

Improving the soil organic carbon (SOC) through sequestration aid in provision of enhancing soil fertility and health. Indian soils are poor in SOC; around 67% of Indian states are low in SOC status (<0.5%). Due to low SOC, most of the agriculture lands are less productive. Unproductive lands are the key cause of low crop productivity and food insecurity. Current population has attained to 7.6 billion (760 crores). Thus, meeting the food demands of ever-growing population within the existing land area is a biggest challenge for the agriculture community. Maintaining the SOC at antecedent level helps to achieve the maximum crop productivity while maintaining soil quality as it improves the soil physicochemical and biological properties.

Thus it is high time for adopting conservation agriculture system intensification (CASI) along with some other technologies such as agroforestry, green manuring, pulse cropping, crop rotation, organic manure application, integrated nutrient management etc., to increase the C sequestration.

Conservation agriculture for land restoration and ecosystem stability

Conservation agriculture has three basic principles such as no-tillage, diversified cropping systems, and residue cover. These three principles help in improving the soil physicochemical and biological properties that directly facilitates in enhancing the crop yields. It has emerged as an alternative sustainable management strategy to improve the crop productivity. The residues returned to the soil under ZT management, can contribute to C sequestration and SOC storage in soil profile for long-term residence. Can manage the sowing time and reduce the time, energy and cost. Changes under ZT provide an opportunity to maintain soil organic C. ZT with crop residue retention favours better soil structure and continuity of soil pores compared to CT.

In the study of Sinha et al., (2019), observed that labile C fraction of soil organic matter, such as hot-water soluble C, provided an early indication of potential effects of ZT on soil organic C. In ZT practice, retention of crop residue on or near the soil surface increases organic C input to the soil, and the minimal disruption of soil aggregates also encourages the retention of organic C and reduces organic C decomposition. SOC and TN was increased significantly after 3 years of ZT. Additionally, the laboratory experiment was conducted by Rakesh et al., (2021) to study the C mineralization/decomposition rates under the surface application and incorporation of crop residues concluded that the residues when incorporated into the soil significantly increase the C footprints through maximum C mineralization; leaving the crop residues on the soil surface reduces the C footprints which helps in achieving sustainability from an environmental perspective. Overall, adoption of soil carbon farming technologies **(Figure 1)** in India, helps in achieving sustainable development goals (SDG).

Government initiatives for achieving land restoration and sustainable agriculture in India

Government of India (GOI) has launched several policy programs to deal with climate change and soil health management. The National Mission of Sustainable Agriculture (NMSA) was initiated to encourage farmers of India for judicious management of existing resources; this mission was under the National Action Plan on Climate Change (NAPCC). In 2015, GOI has established the Soil Health Card (SHC) to recommend the fertilizer dosage for crops based on soil test results which considers 12 parameters, namely N, P, K (Macro-nutrients); S (Secondary- nutrient); Zn, Fe, Cu, Mn, Bo (Micro - nutrients); and pH, EC, OC (Physical parameters).

The Neem-Coated Urea (NCU) which is the slow release nitrogen source of fertilizer has been reduced the bag size (50 kg to 45kg) to minimize the fertilizer usage. In March 2015, GOI made it mandatory for fertilizer firms to produce NCU up to 70% of its capacity and in May 2015, the GOI directed that all fertilizer urea manufactured in the country or imported will have to be coated with neem oil at the rate of 0.5 kg per tonne. The Programs such as the National Project on Organic Farming (NPOF) and National

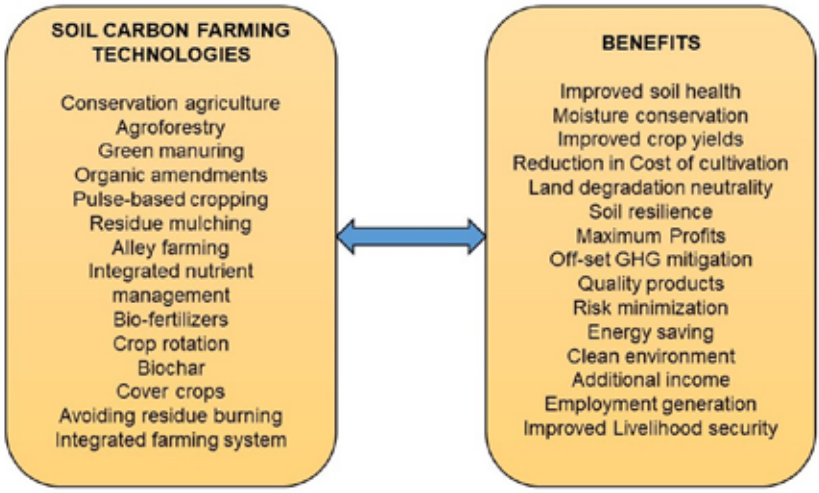

Figure 1. Advantages of adopting soil carbon farming technologies

Agroforestry Policy (NAP) was initiated to enrich the soil fertility along with climate mitigation. The States such as Andhra Pradesh, Himachal Pradesh, Sikkim, etc. have already adopted and promoted organic farming practices on a wider scale. "Sikkim" state recognized as an "Organic State" of India.

A "4 per 1000/4 per mille" initiative was launched by France in 2015 as a part of the Global Climate Action Plan (GCAA) adopted by the United Nations Framework Convention on Climate Change (UNFCCC) at a conference of the parties (COP) 22 and recognized the importance of SOC in achieving sustainability in agriculture system by increasing 0.4% SOC every year.

CONCLUSION

Intensive agricultural operations have been exploiting the available natural resources globally, much faster than they could be renewed has been a debate for decades, perhaps centuries. As a consequence, there is climate change, soil degradation, loss of biodiversity and ecosystem. Adoption of conservation agriculture and encouraging farmers to promote carbon farming through various technologies with proper government incentives and policies enables to attain climate friendly agriculture along with land degradation neutrality through improved SOC.

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Sustainable Use of Poor Quality Waters for

CROP PRODUCTION

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About half of the irrigated area in India receives water supplies through ground water but quantity and quality of ground waters control the production capacity of lands, especially in north-western states of the country. The studies have indicated that 32-84% of total ground water utilized in different states of India is of poor quality. Over utilization of ground water and subsequent flow from poor quality aquifers has endangered the good quality aquifers. Consequently, it is leading to decrease the efficient production for coming time. Indiscriminate use of poor quality water degrades the soil quality and crop productivity due to accumulation of salts and deterioration of soil physico-chemical and microbiological properties. For sustaining the crop production in these soils, salt concentration in root zone should be maintained below the permissible limits.

The basic principles for improving and sustaining the productivity in a salt-affected environment includes 1) modifying the environment to suit the plant and 2) modifying the plant to suit the environment. Properly managed poor quality water may also become a valuable irrigation resource for crop production in these areas. Sustainable crop production in soils receiving saline/sodic water should aim at improving soil health along with controlling salinity/sodicity build-up in soil.

Management of saline/sodic water to maintain crop yields Crop selection

Selection of suitable crops and their cultivars capable of high productivity under varying levels of salinity/sodicity is fundamental factor for achieving sustainable agricultural productivity under saline/sodic irrigation system. Variation in crops tolerance to soil salinity/sodicity form the basis for crop selection in these regions. Rice is most commonly used crop in alkali soils, but it is not recommended to be grown with poor quality water as it needs large numbers of irrigations which can increase salt load or Na build up in soil.

So, growing of low water requiring salt tolerant or semi-tolerant crop should be preferred under poor quality water irrigation. Most of high yielding crop varieties perform well under moderate levels of salinity and alkalinity, while, under high salinity/sodicity, only salt tolerant cultivars produce economical yields. The Central Soil Salinity Research Institute (CSSRI), Karnal (Haryana) has developed salt tolerant cultivars of rice (CSR 23,CSR 27,CSR 36), basmati (CSR 30), wheat (KRL1-4, KRL19, KRL210) and mustard (CS 52,CS 54), which can tolerant high levels of salinity (up to ECe of 7-10dS/m) and alkalinity (pH 9.3-10). Wheat cultivar PBW 343 should be preferred over PBW 550 and PBW 502 to obtain acceptable yield in soil irrigated with sodic water containing residual sodium carbonate (RSC) >5 me/L. Among Bt cotton hybrids, RCH 134 was observed to perform better than MRC 6301 and MRC 6304.

Use of amendments

The adverse effect of alkali water on soil properties can be mitigated by supplying soluble calcium to replace exchangeable sodium on clay surfaces. This can be done in two ways (i) add calcium directly to soil (ii) add chemicals that dissolve calcium from calcium carbonate already present in soil.

Calcium amendments include gypsum, calcium chloride and acid forming substances. Gypsum is most commonly used amendment and easily available in market. Calcium chloride is fast acting but it is costly affair than gypsum. Acid forming amendments are elemental sulphur, sulfuric acid and pyrite. Acid-forming amendments are used only where calcium carbonate is present in soil. Amount and type of amendment required depends on their cost, reaction speed, ease of application and crop tolerance.

In some areas, cheap acidic industrial wastes are also available which can be used for sodic soil improvement. Press mud, a waste product from sugar factories, is commonly used material for soil improvement. Earlier gypsum application was recommended when RSC of irrigation water exceeded 2.5 me/L. However, studies has conducted to decide the amount of gypsum required based on level of deterioration of soil, cropping intensity and water requirement of crop.

Gypsum bed technique using gypsum is also found very effective in North West India. It saves the cost of grinding and broadcasting of powdered gypsum in the field. Addition of organic matter helps in reclamation of sodic soil through mobilization of Ca2+ from CaCO3. Therefore, the need of gypsum requirement for controlling the harmful effects of sodic water irrigation can be eliminated by farmyard manure (FYM) application in rice-wheat cropping system in calcareous soils.

In saline soils, organic materials improve the soil properties, reduce osmotic stress and volatilization losses, and enhance N use efficiency. The application of wheat straw was found less effective than FYM and green manure in increasing the crop productivity.

Fertilizer management

The presence of salts in saline/sodic soil decreases N use efficiency because increasing ECe and pH results in reduction of microbial population and slow N transformation. Nitrification is more sensitive to salinity than ammonification resulting in accumulation of NH3 and nitrites. Major loss of nitrogen in saline/sodic water irrigated soils is ammonia volatilization which increases with increase in EC, RSC and sodium adsorption ratio (SAR) of irrigation water.

To decrease N losses and increase N use efficiency, splitting of nitrogen fertilizer, deep incorporation, application of slow release nitrogen fertilizer and urease inhibitor have been found useful. Application of higher (25%) doses of N fertilizer that of recommended is also found helpful to overcome the adverse effects of salinity. Another better strategy includes substituting a part of chemical fertilizers by organic materials.

Application of organic materials improves physical properties of soil, increases moisture retention and decreases nutrient losses. Choice of fertilizer for crops also depends on composition of salts present in soils or waters. Application of higher dose of phosphorus has better effect on crop yields when saline waters are applied; thus, seem to mitigate the adverse effects of salinity. When crop was irrigated with chloride-dominated water, the yield response to phosphate application was higher as compared to irrigated with sulphate dominated water.

Long term irrigation with saline/sodic water may decrease the availability of micronutrients such as Zn and Fe especially in calcareous soils of arid and semiarid eco-regions. These problems are causing the stagnation in crop productivity in these areas.

Irrigation management

Conjunctive use of water is defined as the management of multi water resources in coordinated operation such that total water yield of system over the period of time exceeds the sum of water yields of individuals components of system resulting from uncoordinated operation. If poor and good quality waters are available either simultaneously or at intervals their conjunctive use is suggested. These waters can be blended in supply network or can be used alternatively which can maintain the exchangeable sodium percentage (ESP).

It is suggested that pre-sowing irrigation should be preferred with good quality water to ensure better germination. For sodic soils, application of light and frequent irrigations is recommended. However, under arid eco-regions, frequent saline irrigations may lead to increased salt accumulation in soil solution. Crop response to short irrigation intervals with sodic waters depends on the season in which crop was grown and its sodium tolerance. Frequent irrigations in summer moderated the soil temperature and increased crop yield over long term irrigation intervals.

In India surface irrigation methods such as border strip, check basin and furrow are most commonly used which result in excessive irrigation, low water use efficiency (50-60%) and non-uniformity in water application. Irrigation methods such as sprinkler and drip irrigation are more efficient. However, saline water irrigation through sprinkler can cause leaf burning and toxicity in some sensitive crops. Drip irrigation has potential to enhance the threshold limits of crop salt tolerance by modifying the pattern of salt distribution.

This results in improved water use efficiency as well as size and quality of vegetable crops. The first requisite for crop production in saline soils is to lower the salinity to acceptable limits by the process of leaching.

The amount of water required for leaching depends on initial salinity, salt tolerance of crops, depth of water table and drainage system. In general, leaching requirement increases with the salinity of water supply and crop sensitivity. The recent research has suggested that irrigation with saline/sodic waters for crop production will increase in future. However, indiscriminate use of poor quality water can directly and indirectly affects soil physical, chemical and biological properties and crop productivity and quality.

Therefore, for ensuring safe use of these waters, management practices like crop selection, conjunctive use of water, appropriate irrigation method, appropriate soil amendments and fertilizer should be adopted for controlling salt buildup in soils. Thus adopting site-specific management of these waters should give an opportunity shift from subsistence farming to progressive farming.

Some tips related to reclamation of saline soils

Following are some methods in brief used for removal of salts in saline soils:

A) Mechanical methods

i) Flooding or leaching down of soluble salts-consider leaching requirement (LR)
ii) Scrapping of surface soil-cumbersome and laborious

B) Cultural methods (crop, soil and water management)

i) Providing proper drainage-artificial drainage (surface and sub-surface)
ii) Use of salts free irrigation water-apply good quality irrigation water
iii) Planting or sowing of seed in the furrow, low salt concentration-escape zone-escape the zone of maximum salt concentration
iv) Use of acidic fertilizers-ammonium sulphate
v) Use of organic manures-high water holding capacity
vi) Ploughing and levelling of land-increases infiltration and percolation
vii) Retardation of water evaporation from soil surface-mulching that intercept the solar radiation
viii) Growing salt-tolerant crops

UDUPI SAREE REVIVAL PROJECT

by Kadike Trust

B C SHETTY
Secretary, Kadike Trust

Udupi saree is one of the finest example of the thousands of years old weaving tradition of India. These delicate looking soft sarees last generations together. After being used as sarees they are used as bedspreads, baby wraps and kitchen towels finally being decomposed completely with almost zero carbon footprints. These sarees are woven only in Dakshina Kannada and Udupi Districts of Karnataka and has GI Tag (registered in 2016) of this region with following specifications.

Udupi sarees are made of fine quality single ply pure cotton yarns of counts 40, 60,and 80. Sarees are woven on Malabar frame looms. Sarees are plain or checkered with contrast coloured Pallu and border with art silk/cotton embellishment. Pallu portion is dyed in dark shades using tie and dye method after the entire warp is prepared. Starch is applied on the loom while weaving to reduce the abrasion of single ply fine cotton yarns. Cut border technic is used while weaving checkered sarees. Motifs are woven with extra weft technic.

Udupi saree weaving with history of 200 years had once more than 5000 weavers and famous with admirers like Kamala Devi Chattopadhyaya founder of Craft Council and Mamatha Banerjee then Railway Minister and current CM of West Bengal. Bulk demand from other districts, slowly came to diminishing mode. The situation became worse since 1980 with no demand from outstation and local due to many reasons, Kadike Trust Karkala a Not For Profit Trust with objective of Nurturing Sustainable Rural Livelihoods entered scenario three years ago. Situation was grim with just 42 weavers and their average age above 65.

Kadike Trust started the Revival Efforts with many hurdles like.. 90% of weavers with age above 55 and up to 83 years, No new weavers below age 50,Wages per Metre was very less.

Products sold at societies for lesser price than cost, and still customers bargained. There was general opinion that these sarees were for aged and labour class women.

There were Very few buyers for these eco-friendly sarees. Out of Eight weavers societies only five were functioning along with one KHDC unit., User authorisation of GI Tag was not procured by them. Trust started the Revival Efforts through 'Save Udupi Saree 'Campaign keeping Talipady weavers society as base, there were only eight weavers in this society. Trust coerced the Talipady society to increase the wages assuring them of fetching better price for products.

Trustees helped society in marketing the products with zero profit initially by personal meeting, participating in various programs like road side farmers markets, organizing awareness program and exhibitions, handing out brochures and leaflet wherever possible etc. After the effort of Kadike Trust Talipady weavers Society obtained authorisation to use GI tag in 2020.

Mamatha Rai, President of the Trust managed Social media platforms 24×7, Facebook page 'Udupi Saree Revival 'Twitter, WhatsApp, Instagram were updated frequently. People responded positively and were impressed by the real life stories with photographs, and the followers for Facebook page swelled to nearly 4000. Since the demand for sarees from distant customers started coming, Mamatha volunteered herself to market them through online platform. Small profit margin kept was used for revival related works. Many followers turned loyal customers and strong supporters of the campaign.

Since there was no proper branding, Trustees requested Mr Sachidananda, a designer friend from Mysore, and attractive logo was created. He voluntarily designed beautiful labels with GI logo, name and photograph of every artisans of Talipady. This initiative gathered appreciation from supporters and buyers started to ask for their favourite artisans products with whom they became familiar through Facebook page.

Along with MD Madhava Shettigar and President Ananda Shettigar of Talipady Society , trustees personally contacted weavers who had left the profession and persuaded them to comeback. Few skilled weavers returned

to weaving, some after 30 years of break. Mr Sanjeeva Shettigar is one such highly skilled multi talented 80 count weaver who came back to weaving after 9 years of break at the age of 72.

Trust arranged a training program for comeback and new weavers. Trust organized Natural dying training for dyers and by experts in the field like Charaka, Dr Sanghamitra Desai and Mr Ashok. First time in the history of Udupi Saree weaving naturally dyed sarees were produced at Talipady. These sarees became a great hit among the buyers and are pre booked. Trust started to honour weavers by giving Uttama Nekara awards. This raised the spirit of weavers and their families, now the community and youngsters started showing interest, this brought dignity back to the profession. Trust recommended names of Weavers with high skills to awards given by other organizations.

All Weavers societies increased wages and product price as demand increased, Talipady society gave Bonus after 16 years. Knowing the importance of this eco-friendly products, responsible customers fully supported the price increase. Trust supported weavers from other societies along with the weavers of Talipady in times of medical emergency. A weavers welfare fund was started at Talipady society by the Trust, Trust gave honorarium to all the artisans of three

societies, During the last pandemic time Trust supported few needy artisans. NABARD Karnataka gave timely support for the campaign by a grant to conduct a training program in March 2020 for Ten weavers and sponsored five looms, five other looms were arranged by the Trust.

Encouraged by the success of the first training for Ten Trainees, Nabard Karnataka came forward to arrange another weavers training in December 2020 for Ten new weavers and advance training for ten who were trained aready. Focus was given to overall development of trainees. Along with weaving training, skill development training like, embroidery, ikat, block printing, screen printing, bag making was given to these trainees so that weavers without loom at home can earn more during free time.

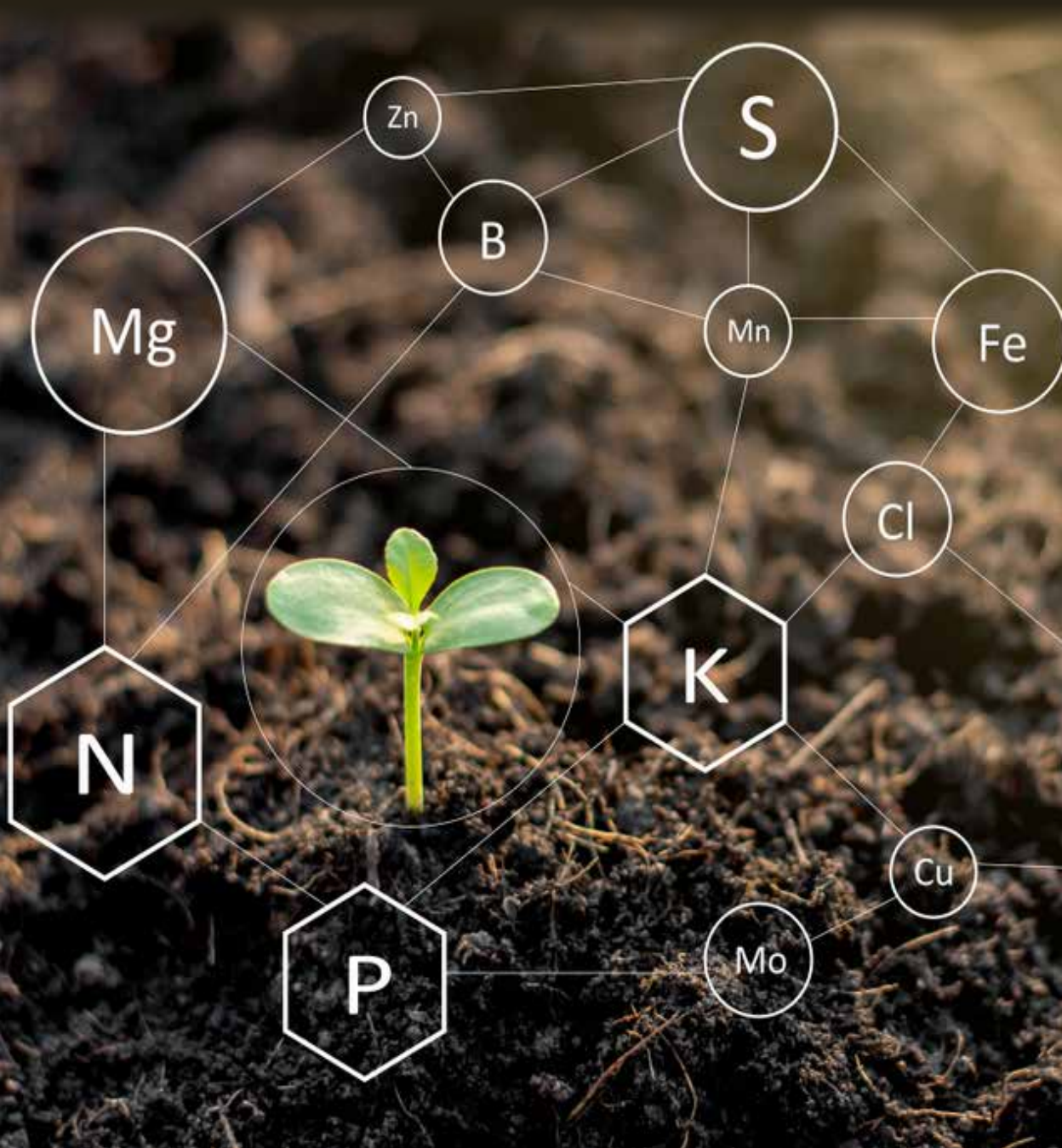
Weekly meetings are conducted to discuss freely about the day to day problems and solutions are found out with trainees involvement.These efforts have yielded good results. Weavers number increased at Talipady from 8 to 34, bringing total numbers in two districts to 70. Demand increased to many folds from all over the country and aboard and thus we understood that the brand Udupi Saree was established by now.Young weavers started joining weaving profession with us. They at present feel proud now to be associated in this profession. They need our support and encouragement to continue their work.

Noticing the work done by the Kadike Trust, Deccan Herald leading daily honoured Mamatha Rai President of Kadike Trust as one among 21 Change Maker of Year 2021. Mamie's Natural Dye education Institute, Cape Brenton, Canada granted Scholarship for their online natural dying course to Mamatha Rai.V T P C nodal agency for GI Registrations assigned Diagnostic study and swot analysis of Udupi Saree Weaving to Mamatha Rai. Study report along with the roadmap for future intervention was submitted to VTPC.

These recognitions have raised the responsibility of Trust to next level. Trust bows to all senior weavers who were selflessly weaving in spite of various difficulties till Kadike Trust started revival effort. Kadike Trust has achieved its goal of Udupi Saree revival with the support of Talipady weavers Society, NABARD, customers, well-wishers and few volunteer donors.

Now it is the responsibility of the government, weavers Societies and people of the region to carry forward the momentum set by the Kadike Trust.

Application of RS and GIS IN SOIL MAPPING FOR LAND RESTORATION



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Importance of RS & GIS in agriculture

Agriculture is one of the major primary sectors in the Indian economy. India being the world's largest producer of rice, wheat and pulses must keep up its pace with growing digital technologies. Over the past few decades, Remote Sensing (RS) and Geographical Information System (GIS) have played an important role and grown exponentially in many sectors for visualization, monitoring, management and potential development. These technologies help us to get reliable information of natural and man-made features, processed and interpreted phenomena occurring over the earth's surface without making any physical contact. Remote sensing (RS) is one of the most important PA technologies that provides a diagnostic tool that can serve as an early warning system, allowing the agricultural community to intervene early on to counter potential problems before they spread widely and negatively impact crop productivity. RS serves as an early indicator to detect potential problems and provide opportunities to address these problems in a timely manner.

Application of RS & GIS in agriculture

Soil Properties

Soil properties such as moisture, compactness, structure and texture are important in farm management practices as it has a direct effect on the yield output. Change in land use system and land management practices result in changes in soil physicochemical properties which impacts soil sustainability. Water content available within the soil is a very important factor that is taken into consideration by soil moisture mapping.

Crop Sown Area Estimation

Estimation of crop sown area is one of the major applications of RS in PI. RS imagery data such as Sentinel-1, 2, Landsat-8, World View-3, LISS-IV, etc., provide precise level crop sown area and helps in crop loss assessment due to various catastrophic disasters. The estimates include the total sown area of crops and vegetables like paddy, cotton, wheat, pulses, potato, peas and more.

Crop Health Monitoring

Normalized Difference Vegetation Index (NDVI) is primarily used for the assessment of vegetation dynamics, particularly in determining crop health status. NDVI greatly reduces the fieldwork and thereby cost of analysis. NDVI is measured using mathematical calculation of spectral bands within the satellite image which measures the healthiness of vegetation, as it has a robust correlation with green biomass indicating healthy vegetation of crop.

Crop Diseases Identification

RS technology provides spatially distribution of i nformation of diseases and pests over a large area which less fieldwork and relatively low cost. With the help of satellite imagery and spatial analysis techniques, crop infected areas are identified like Mealybug, Plant Hopper, and White Fly to get an overview for evaluating the potentially infected areas.

NATCAT Modelling

Natural Catastrophe (NATCAT) causes huge human losses and damages extensively, prevention of these catastrophes is not possible and hence preparedness is more useful. In this line, NATCAT mapping is getting more importance nowadays. RS data is more useful in providing essential data for mapping and GIS facilitates arriving at a suitable conclusion. NATCAT modelling is a system to estimate the real-time or possible forecast of risk assessment, using the probabilistic approach to predict the outcome and behaviour of natural hazards.

This includes risk mapping and measuring hazards through computer-simulated catastrophe models where scientific studies and historical occurrences are linked with GIS. The estimation is commonly derived from various hydrological and remotely sensed data where the process ensures that areas having higher depth of inundation will be assigned a high 'hazard denomination'.

Flood Impact

In India, during the monsoon majority of the agricultural area is damaged due to flash floods. Satellite RS provides significant information through the use of satellite imagery along with ground-based data collected from ground surveying teams, to compute precise damage assessment. The damage assessment of floods can significantly improve the role of land use planning in managing flood risk. Flood risk maps are prepared depending on the estimated depth of inundation of flood.

Crop Damage Assessment

The recent advancement in RS with the introduction of Drones imagery analysis is very useful in micro level-crop assessment for crop loss due to hailstorms, diseases and pest infestation. The accuracy of drone image data is directly related to the spatial resolution of the input imagery as the spatial resolution is very high ranging from 50 cm and increase as per the requirement.

Weed Identification and Classification

The concept of "patch spraying" has got wide acceptance over the conventional method of spraying which has major disadvantages such as excessive and unnecessary use of herbicides. The advanced RS system started with high-resolution imagery, digital weed identification, followed by the integration of spray flow control algorithms and electronics to existing sprayers to turn the sprayer nozzles on and off, depending on the existence of weeds at a given GPS coordinate in the field. In addition to high-resolution imagery, advanced image analytics are critical to the accurate identification and classification of weeds. The optimal resolution of RS data required for weed mapping often times depends on how different the crops are from weeds at certain growth stages.

Yield prediction and Grain quality assessment

Crops are subject to biotic and abiotic stresses during the growing season, which can influence the quantity and quality of grains. Presently some farmers rely on yield-monitoring systems to collect yield information. A yield monitor typically aggregates yield information from multiple crop rows at the time of harvest. Some studies demonstrated that crop yield can be predicted with the use of visible imagery. The accuracy of yield prediction models is directly dependent on crop growth stages. The increased accessibility to more RS data and the development of advanced data analytics are likely to advance research towards the development of crop yield forecasting systems.

Grain quality because of its impact on nutritional value, as well as the profitability of the production system. Some studies showed that success in predicting grain protein using RS imagery and reported the importance of the growth stage and spectral resolution in an accurate assessment of grain protein. Wang et al. reported wheat grain yield and protein content by analyzing and comparing multitemporal imagery from SPOT5 and HJ-1 CCD.

Crop residue assessment

The management of crop residues is critical in order to improve soil quality and crop productivity. Earlier studies showed the potential of RS for mapping the spatial distribution of crop residues in agricultural fields. Sharma et al. used multispectral satellite imagery from Landsat ETM+ and Landsat OLI for crop residue assessment in Maize and Soyabean. Nevertheless, Galloza et al. found hyperspectral-based indices performed better than multispectral-based indices. Limited studies on site specific tillage practices for residue management indicates potential opportunities to employ advanced RS technologies to monitor crop residue for soil, water and nutrient management.

How RS & GIS useful in land restoration…??

Acidity

Acidification of soil is a significant land and water management issue, being responsible for denuded acid scalds, lost agricultural productivity, poor water quality, altered ecology and infrastructure damage. Gamma-radiometric surveys are an important tool for mapping the properties of soils and their parent geological material. The Image data of the concentration of gamma-ray emitting elements, such as potassium (K), thorium (Th) and uranium (U) were used in identifying acid soils.

A regional airborne radiometric survey in the coastal zone of northern New South Wales was assessed to identifying acid soil areas. The thorium concentration imagery is the useful source for mapping areas of active acidification. The thorium concentration in soils is negatively correlated with acidification of the soils, as the thorium concentration is more then the soils are less acidic because of the solubility of thorium is greatly enhanced in the acidic, sulfate- and organic-rich groundwaters areas (Bierwirth and Brodie, 2005). Depletion of uranium also occur in the similar manner.

Salinity

RS is an efficient tool to expand the physico-chemical analysis to large spatial scales in a span of decades. The Landsat MSS data to examine the temporal changes of salt-affected soils in the Indo-Gangetic alluvial plain (Dwivedi,1996). With principal component analysis, the study

extracted soil brightness and vegetation greenness from spectral reflectance to examine the changes in the extent of salt-affected soils. The moderate resolution imaging spectroradiometer (MODIS) images were used to produce soil salinity maps. The MODIS imagery, assisted with soil sampling data, was also used to measure soil salinity (Shamshi et al., 2013). Digital image processing techniques were also applied to detect soil salinity/ alkalinity using multi-spectral imagery. LISS-II sensor of IRS-IB satellite has been used to analyze the effectiveness of several indicators for the presence of salts, i.e., salinity indices, normalized differential salinity index and the ratio of the signal received by the sensors in the third spectral band to others.

And also used two classification processes (COMPOSITE MODULE and ISOCLUST function of GIS IDRISI) that performed classification based on specifically create the image. Both schemes have been shown to perform good classification. (Khan et al., 2001). The good predictions can be made based on bagging PLSR (Partial Least Square Regression) using first derivative reflectance (Validation R2 =0.85), PLSR using untransformed reflectance (Validation R2 =0.65), and the untransformed individual band at 2257nm predictive models. These suggested the potential of mapping soil salinity using airborne and satellite hyperspectral data during the dry season (Mashimbye et al., 2012).

Waterlogging monitoring

Satellite remote sensing coupled with Geographical Information Systems (GIS) offers an excellent alternative to conventional mapping techniques in monitoring and mapping surface and sub-surface waterlogged areas. Normalized Difference Water Index (NDWI) was used primarily to delineate surface waterlogged areas. Indian Remote Sensing (IRS-1D) Linear Imaging Self Scanning Sensor (LISS-III) data acquired during the period 2002–2003 were used to assess the water-logged areas in Bihar. (Chowdary et al., 2008).

Soil fertility mapping

Studies conducted by Rahman et al. (2018) on the importance of GIS in building land resource database of soil which is very much necessary for better monitoring of soil properties for optimal sustainable resources. An approach towards justifying such concerns is site-specific nutrient management which takes into account spatial variations in nutrients status, thus cutting down the possibility of over or underuse of fertilizer. Geographic information system (GIS) is a powerful tool that helps to integrate many types of spatial information such as agro-climatic zone, land use, soil management, etc. to derive useful information (Adornado and Yoshida 2008). Furthermore, GIS-generated soil fertility maps may serve as a decision support tool for nutrient management (Iftikar et al. 2010). A number of studies on soil fertility mapping have been documented (Ravikumar et al. 2004).

Conclusion

The integration of RS and GIS is found to be effective in determining and extracting land use and land cover which provide valuable information necessary for planning and research. Quantifying crop loss monitoring, classification of weeds, identification of pests and diseases, grain quality monitoring including soil fertility and soil water nutrient dynamics have been less explored through the application of RS and GIS and deserve further investigation. Conclusively, there is a need to develop spatial models to support site-specific planning and management is a vital concern even though the presence of general planning and management are present.

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Agricultural Technologies for Sustaining Soil Health in

HILLY AGROECOSYSTEMS OF UTTARAKHAND

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Most of the area of the Uttarakhand state is under forests and wastelands thus leaving land area 7.41lakh ha (about 14%) (LUS 2009-10) for cultivation out of the total reported area of 56.72 lakh ha.Out of the total, about 89% are under small and submarginal.Since a large number ofthe area is under small and marginal holdings, the scale of economies cannot be availed of, and so the input cost per unit of output is higher. The soil in the Tarai region is extremely fertile and supports a diverse range of crops. Because of excessive or imbalance use of chemical fertilizers and overexploitation of groundwater, thesoiloftheMostregionhasbecome less fertile, resulting in a decrease in productivity's long-term viability.

On the other hand,the hilly regionis prone to constant soil erosion as a result of steep slopes, making it less fertile, which could be avoided by better management practices. Due to a growing population and over-exploitation of resources, the Indian Himalayan highlands are undergoing ecological and socioeconomic changes. Mountains, as a fragile environment, are more vulnerable to climate change and rising temperatures, which are 0.74°C higher than the global average over the last 100 years.The main sources of livelihood for inhabitants living in hills are agriculture, livestock, and forest produce.

Changes in forest biodiversity from broadleaf to pine trees, declining crop productivity due to reduced soil fertility, outbreak of new pests and diseases, and weather calamities as a result of changing climatic conditions have posed someserious threats to food and fodder security in Himalayan ecosystems. Furthermore, in order to improve the overall resilience and sustainability of the system to cope with climate change, these methods should be supported by policy and legal changes for fair implementation.

Status of organic farming in the Tehri Garhwal district of Uttarakhand

Organic farming is a system of sustainable farming that produces agricultural products without the need for artificial pesticides or fertilizers. Now the situation is that even by increasing the fertilizers, it is not possible to increase production. Soil is losing its own characteristics and at the same time, the chemical pesticide kills the beneficial insects present in the field along with the harmful ones.

But if we talk about the hilly region of Uttarakhand the farmers used to grow crops without adding any of the chemical fertilizers. The main objectives of adopting organic farming in hills of the Uttarakhand are to make farmers aware of the fertility status of their fields and use the farm wastes such as farmyard manure (FYM), crop residues, and other locally available organic inputs in a sustainable manner.

And to encourage the production and use of organic and biological sources of nutrients like bio-fertilizers, organic manures, composts and vermicomposts **(Fig. 1) f**or sustained soil health and fertility status. Therefore, organic farming entails maintaining the agroecosystem as anautonomous system based on the primary production capacity of soil under local climatic conditions. On average, the organic carbon status of the TehriGarhwal region is high which ranges from 0.58% to 1.98% with an average of 1.28% (high) because farmers use only FYM, vermicompost,and crop residues in their field.

In-situ water harvesting

The villages of the hilly region of Uttarakhand face the problem of low and uncertain productivity of crops because of recurrent and intermittent drought and also low and erratic rainfall. The soils are sloppy (2-4%) and shallow depth (10-15 cm). Most of the part of Uttarakhand is rainfed and farmers are totally dependent on rainfall for their crop production.So for conserving water for irrigation purposes, rainwater harvesting tanks, farm ponds, check dams, and similar water storage structures which are either renovated/desilted or newly constructedin several villages.

This water is put to use for various purposes like domestic purposes, irrigation, raising livestock, and also production of fish. The enhanced storage of harvested rainwater led to a rise in the level of water in the open and borewells in the vicinity which could be utilized for irrigation for an extended period covering more crops.

Mulching for moisture conservation

Plastic mulching **(Fig.3)** is also demonstrated to conserve soil moisture and temperature in the field itself as well as reduce soil erosion.

Generation of soil health card in hills

The soil health card scheme aimsto provide soil health cards **(Fig. 4)** to the farmers so that they know the nutrient status and other information of soils in their land holdings and further recommend fertilizers and dosesfor the balanced use of fertilizers in their field. The Government of India initiated the scheme to issue soil health cards to about 14 crore farmers spread all over India. This card is in the form of a printed report. The soil health card will be issued to all landholders every three years. Nowadays with the development of the new technologies, scientists from the different agricultural departments work for the easiest methods for soil fertility and quality assessment for monitoring of agricultural lands (Fig. 4).

The information mentioned in the soil health cardis pH, electrical conductivity (EC), organic carbon, Macronutrient like available nitrogen (N), phosphorus (P), potassium (K), sulphur (S), calcium (Ca),magnesium (Mg) and micronutrients like available zinc (Zn), boron (B), iron (Fe), copper (Cu), and manganese (Mn) based on the measures soil test values.The soil health card will give the farmers a proper idea about which nutrients is deficient in their soils or which crops they should need to grow in that particular soil and also give information on which fertilizers they need to apply and also give an idea about the crop-wise recommendations of nutrients and fertilizers requirements in each crop and soil which can help in increasing the crop production.

The government, along with the agriculture department, has launched a soil health card portal. This is a single, generic, uniform, web-based software accessed at the link www.soilhealth.dac.gov.in. Soil Health Card portal aims to generate and issue Soil Health Cards (SHC) based on either Soil Test-Crop Response (STCR) formulae developed by ICAR or General Fertilizer Recommendations provided by State Governments.

This portal contains cycle 1 and cycle 2 in which information regarding samples collected, samples tested, SHC printed, and SHC dispatched are presented and also have nutrient status according to block-wise, sample-wise, village-wise, farmer-wise, grid-wise, district-wise, and state wise. So the farmers get their SHC from this portal.Thus, the SHC is truly representative, much convenient, precise, cost-effective, and easily understandable to the marginal farmers.

Nutrient deficiencies in soil

Nutrient deficiency occurs when a plant lacks a sufficient quantity of an essential nutrient required for growth and without sufficient essential nutrients, plants will not grow well and show various symptoms to express the deficiency. Symptoms of nutrient deficiency may include stunted growth, death of plant tissue or yellowing of the leaves caused by a reduced production of chlorophyll, a pigment needed for photosynthesis. Nutrient deficiency can have a significant impact on agriculture, resulting in reduced crop yield or reduced plant quality.

Therefore, careful inspection of the growing plant can help identify specific nutrient stress. If a plant is lacking in a particular nutrient, characteristic symptoms may appear. The deficiency of a nutrient does not directly produce symptoms. Visual evaluation of nutrient stress should be used only as a supplement to other diagnostic techniques (i.e., soil and plant analysis).

Nutrient deficiency symptoms may be classified as follows:

1. At the seedling stagecomplete crop failure occurs
2. Severe stunting of plants.
3. Appearance of specific leaf symptoms at varying times during the season.
4. Internal abnormalities such as clogged conductive tissues.
5. Delayed or abnormal maturity.
6. Poor quality of crops, including differences in protein, oil, or starch content and storage quality.

Fig.1 Vermicompost unit and FYM in Tehri Garhwal

Fig. 2 Water Harvesting Tank

Fig. 3 Plastic Mulching

The visual symptom may be caused by more than one nutrient. Deficiencies are actually relative, and a deficiency of one nutrient may be related to an excessive quantity of another. In the field, it might be difficult to distinguish between deficient symptoms and disease or insect damage because can mimic some micronutrient deficiency. Some of the terms used to identify the deficiency symptoms.

Chlorosis: Leaves or plant parts become abnormally yellow due to a lack of chlorophyll. It occurs due to deficiency of mineral elements like Mn, K, Zn, Fe, Mg, S, and N Mottled: It is a pattern of irregular marks, spots, streaks, blotches, or patches of different colours on thesurface (anthocyanin development). It is due to deficiency of N, Mg, P, S.

Necrosis: It refers to a patch of dead tissues on leaves, stems, and other parts of the plants. This occurs due to the deficiency of Mg,K, Zn, Ca, and Mo.

Women empowerment in agriculture during COVID-19

On the other hand,women play a vital part in the mountainous region of Uttarakhand state. The women of the hills of the Uttarakhand state work extremely hard. They toil all day, starting with household chores, caring for children and cattle, and venturing out for fodder, fuel, and drinking water. Despite that women are aexcluded from the decision-making process as well as development procedures.

There are numerous programmes aimed at empowering women in terms of education, welfare, and economic development, they still lack access to basic amenities. In this situation, women's self-help organizations play an important part in resolving the problems and implementation of innovative government programmes such as MahilaSamakya (women's empowerment) by mobilizing women for self-empowerment. The agriculture system prevailing in the hills of Uttarakhandhas marginal and low productivity in terms of area and productivity.

About 80% of hill agriculture land is terraced slops, which is fully dependent on rain, while the other 20% is in valleys and plains, which arewell irrigated.Small millets occupy an important place in the agriculture of Uttarakhand especially in hilly regions.

Finger millet (Mandua) and Barnyard millet (Jhangora)are the most growing crops in the hills of the Uttrakhand which is successfully maintaining high productivity. Millets are rich in fibre, calcium, iron, and micronutrients as well. Millets have been converted into nutritious and novel foods, making them more acceptable to the people, particularly the rural people, for nutritional security and economic production.

So there are several initiatives taken by the collaborative efforts of Govt. Departments such as KrishiVigyan Kendra,TehriGarhwal, IFAD-ILSP, and Women Empowerment & Child Development to strengthen rural women of Garhwalby providing training to develop Health Food, i.e.,iron laddu/ball for anaemic adolescence girls. The recipe was standardized by KVKScientist.

The training has been provided to Women Cooperative of IFAD-ILSP namely Belmati cooperative, Gaja by KVK. The prepared laddu has been purchased by the Department of Women Empowerment and child development & distributed to anemic girls in Govt. schools under Kishori Shakti Yojna. This initiative gave regular employment to women, made them more empowered, and differences in their lives by achieving independence.

There are several schemes for the women given below:

1. Integrated Livelihood Support Project supported by Uttarakhand GramyaVikas Samiti & International Fund for Agricultural Development (IFAD) commenced in January 2015 in Chamba block of district TehriGarhwal and Uttarkashi district.

2. Uttarakhand Women Integrated Development Scheme: It aims to reduce women's workload in their daily lives by increasing their decision-making capacity and increasing their understanding of the Panchayati Raj System and women's self-employment. The main objective of this scheme is a reduction in poverty by facilitating rural households to take up sustainable livelihood opportunities integrated with the wider economy.

3. Nanda Devi KanyaDhanYojna: The scheme intends to offer women monitoring assistance during the birth of a girl child in order to decrease gender discrimination and female foeticide.

Fig. 4. Soil Health Card

4. UjjwalaYojna: To bring the women engaged in immoral earnings to the mainstream and to provide them shelter, the "Ujjwala" scheme is being conducted.

5. SampoornaRojgarYojna (SGSY) in rural areas and Swarna Jayanti Shahri RojgarYojna (SJSRY) earmark 30% of labour opportunities for women.

6. The Mahatma Gandhi Rural Empowerment Guarantee Scheme enhances livelihood security in rural areas by providing 100 days of empowerment for every household where at least 30% of beneficiaries are to be women it has been found that about 48% of the total beneficiaries of the scheme are women.

These schemes help women by allowing them to develop their own independent identities through economic empowerment, eliminating all forms of exploitation and discrimination, providing access to education, maternal and child health care, and ensuring their rightful share in resource allocation and decision-making.

So that they can become equal partners in the family, society, and the process of nation-building.

Fig. 5.Methods of soil sampling/soil testing and distribution of soil health card

Potassium deficiency in Apple

Potassium deficiency in Apple

Fig. 6. Nutrient deficiency symptoms in fruits crop

DRAGON FRUIT

A New Entrant in Kerala Fruit Basket

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Kerala's fruit market has witnessed a wide transition in the consumption pattern and acceptability of exotic fruits. Recognising the health attributes, exotic fruits like dragon fruit, have captured the hearts of common public in a meantime. Dragon fruit, recently renamed as "Kamalam", has become the consistent member in our state's fruit basket.

Dragon fruit (Hylocereus sp.) is a tropical/subtropical fruit belonging to the family cactaceae. It is native to Mexico and Central/South America and is popular across Southeast Asia. The fruit is cultivated in Karnataka, Kerala, Tamil Nadu, Maharashtra, Gujarat, Orissa, West Bengal, Andhra Pradesh, and Andaman & Nicobar Islands with an estimated total area of less than 400 ha.

It is also well established new crop in China, Malaysia, Taiwan, Australia, Vietnam due to its least care requirement for its cultivation and minimal attack of pest and diseases. The biggest achievement of this crop is that once planted, it will grow for about 20 years, and one hectare could accommodate about 800 dragon fruit plants.

Dragon fruit is a herbaceous fast-growing perennial climbing cactus that grows up to 10 m long and requires support for growth. The stem is triangular, three-sided, green, fleshy with undulating horn-like margins bearing spines. The aerial roots, capable of absorbing water, are produced on the underside of stems and provide anchorage for stems on vertical surfaces. The flowers are white and large, bell-shaped, produce a sweet fragrance when in bloom, and require a long day for flowering. The beautiful night-blooming flowers give its nickname "Moonflower" "Noble Woman" or "Queen of the Night". The fruit is a fleshy berry, oblong to ovoid, with bright pink and yellow-skinned varieties which are covered with bracts or "scales', hence the name dragon fruit.

The pulp is delicate, juicy, and contains numerous dark edible seeds of approximately 3 mm diameter. The fruit normally weighs from 150 to 600g. Dragon fruit is also known as Pitaya, Strawberry Pear, Night-blooming Cereus, Belle of the night, Cinderella plant, and Jesus in the Cradle. There are three cultivated species of dragon fruit.

They are; Hylocereus undatus Britt and Rose (white-fleshed pitaya) with oblong shaped fruits weighing about 300-800g, H. polyrhizus (red-fleshed pitaya); H. costaricencis with violet-red flesh, red/pink peel; Oblong fruit weighing about 150-400g and H.(Selenicerus) megalathus (yellow pitaya) with ovoid or oblong fruits which weigh about 120-250g. H. undatus Britt and Rose is the most cultivated and consumed species of dragon fruit. Dragon fruit is considered as a super fruit with high nutritive and medicinal properties. It helps to lower cholesterol and cardiovascular problems, boost immunity and metabolism, helps in digestion and lower blood sugars in type 2 diabetes, prevent cancer, premature aging and has wound healing property.

The seeds contain natural oils and fatty acids in the form of linoleic acid and oleic acid (Omega-3 and Omega-9), which are useful for cardiovascular health. Dragon fruit is an important source of phytochemicals such as polyphenols, flavonoid and vitamin C which are related to antioxidant activity.

Cultivation practices

Dragon fruit plant prefers a dry tropical climate with an average temperature of 20-29°C and can withstand temperatures of 38-40°C, and as low as 0°C for short periods. It can be grown on a wide range of soils from sandy loam to clay loam with 5.5 to 7 soil pH.

Propagation

Dragon fruit plants can be easily multiplied through stem cutting. Generally 20-25cm long stem cuttings should be taken from elite mother plants after the fruiting season, treated with fungicides to prevent diseases and planted in 12 x 30 cm size polyethylene bags, filled with 1:1:1 ratio of soil, farmyard manure and sand. The bags are kept at a shady place for rooting. Excess moisture should be avoided to prevent rotting. These cutting roots profusely and become ready for planting with 5-6 months and start flowering within 12-18 months after planting. Seed propagation results in smaller seedlings with thin stem even after one year of planting and the plants produced from seeds are not true to type and there is lot of variability among the plants; hence seeds are generally not used for commercial multiplication of dragon fruit.

Planting

Dragon fruit plants prefer full sunlight open areas, green house cultivation is also recommended. Planting should be done in the rainy season for better establishment. As climbing cactus with a weak and segmented stem, it requires vertical pole support for optimum growth and fruiting. Growing them flat on the ground is not recommended, due to difficulty in cultivation (pollination, harvest, etc.), because contact with the ground causes damage to the vines.

Dragon fruit are thus best grown on vertical or inclined living or dead supports made of wood or cement and iron posts. Generally in single post system planting is done at 3x3 m distance and in paired row system, planting is done at 6x2 by 2x6 at 1 m distance. The number of plants per pole may be 2 to 4 depending on the climatic condition. Single pole system showed better performance in growth and yield when compared with another trellis system. For planting, pits of 60 x 60 x 60cm are dug, filled with top soil, farmyard manure or compost with 100 g of super phosphate and small brick pieces and sand are added for drainage.

Pollination

Flower production generally takes place during April-August in the humid tropical conditions. It is cross pollinated and flowers open in the night and remain open during night up topollination. Generally honey bees and dragon flies are the pollinators. Manual pollination is simple and may be carried out before anthesis, from 4:30 P.M. until 11:00 A.M., the next day. These manual pollinations are worth undertaking as the fruits obtained are of excellent quality.

Intercultural Operations

The root system is superficial and can rapidly assimilate even the smallest quantity of nutrients. The fast growing vines produce more thick dense of branches in initial stage and the removal of stem tip induces lateral branching. It is important to arrange round metal/concrete/rubber frame to maintain balanced shrub. Major pruning is carried out during first year after planting. The well grown vine may produce 30 to 50 branches in one year and more than 100 branches in 4 years. The post-harvest pruning encourages the growth of new young shoots that will bear flowers in the following year. Irrigation should be provided during dry season and frequent dry period without irrigation reduces the yield and quality of fruits. Approximately 1 to 2 litres of water per day per plant is sufficient during the summer/dry days.

The creeping and climbing type weeds should be removed periodically as these entangle with the vines and affect the growth and yield.

Pests and Diseases

It prefers full sunlight open areas and sunburn injuries are noticed in many parts of India during March and April. Though dragon fruit is tolerant to major pests, minor pests like mealy bugs, termites, ants and scale insects are reported in dragon fruit. Important diseases that affect dragon fruit crop are anthracnose (Colletotrichum siamense), brown spots, and stem rots (Xanthomonas campestris and Erwinia carotovora). Proper drainage, wider spacing, adequate air circulation and proper sunlight help in minimizing the diseases.

Harvesting

Dragon fruit plant normally bears fruits after 18-24 months of planting and fruits are ready for harvesting at 30 -50 days after flowering. The most important maturity criterion is the change in skin colour to almost either red or yellow depending upon the cultivar. The most common harvesting practice is manual by twisting the fruit which often damages the skin and mechanical harvesting using knife/secateurs/ shears can be carried out to overcome the damage. The fruit weight ranges from 300-800g and each plant produces 40 to 100 fruits per year. One plant normally yields 15 to 25 kg of fruits and the price ranges between Rs.125 to 300 per kg.

Postharvest Management

Dragon fruit is non-climacteric and has a short storage life due to high respiration, weight loss, and increased ripening process which causes shrivelling of fruit by eighth day of harvesting. Suitable postharvest handling practices are to be adopted for enhancing the shelf life of fruits.

Harvested dragon fruits should pre-cooled immediately to remove the field heat before loading into containers for exporting. Based on the physical characteristics, dragon fruit is either graded into extra, class I, and class II categories or based on fruit weight by Codex Alimentarius. Recommended storage temperature for H. undatus and H. polyrhizus is 10° C and for yellow pitaya it is 6°C with 85–90% RH. Different physical (edible coating, heat treatment) and chemical treatments have been standardized to extend the shelf life of dragon fruit. Chilling injury, decay, mechanical injury, and moisture loss are the main postharvest disorders associated with dragon fruit.

Processing and value addition

Dragon fruit can be grown as an ornamental crop as well as for consumptions. The fruit pulp can be used for fresh, culinary and confectionery purposes. It can be fermented as wine, used in fruit salads and for the extraction of functional enzymes. Frozen pulp may be used to make yogurt, candies, ice cream, marmalade, jelly, juice and pastries etc. Seeds have application as an ingredient in many food products and are utilized to extract oil which contains about 50% essential fatty acids. Unopened flower buds are cooked and eaten as vegetables. Both fresh and dried dragon fruit skin are rich in pectins and betalains making it natural food thickener and natural colouring agent.

Conclusion

Dragon fruit was declared as the super fruit in 2013 by USFDA and has the potential to be an integral part of the Indian fruit basket. Being succulent, the growth and water requirements are very less, they are less prone to the incidence of pests and disease and year-round production can be ensured which assures the growers a sustainable income. In India, the barren lands can be turned into dragon fruit cultivation belts. The vast number of processing opportunities further keeps the door open for the produce. Surplus produce can be processed and yet several avenues of value addition need to be explored. The never-ending nutritional and health benefits of this highly profitable commercial crop have made it the farmer's favourite. Interestingly many farmers have shifted to dragon fruit cultivation and value addition activities, clearly showing the market potential of fruit.

Utilization of Saline Areas in Northern India

BY CULTIVATION OF VANNAMEI SHRIMP

A Silent Revolution

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Brackish water shrimp farming, which was initially started in a big way during nineties in the coastal areas proved to be very remunerative. Incidentally, in many pockets in the inland states, prevalent in northern states like Rajasthan, Western Uttar Pradesh, parts of Punjab, Haryana and even elsewhere the subsoil water has become saline or semi saline due to some or the other reasons. Getting encouraged from the successful pilots conducted by the CIFE, Rohtak (ICAR), the farmers have started converting their saline land into shrimp farming and cultivating white legged shrimp i.e. Litopenaeus vannamei.

Being relatively expensive and to some extent risky and skillful venture, as at present, mainly bigger farmers have started cultivating shrimps in these saline lands. Utilising the saline lands for shrimp farming can be a game changer not only for the farmers but also for the country as whole as shrimp is a high value commodity and also has a high export value.

India is endowed with a long coastline and hence offers scope for large utilization of marine wealth. Since long, fishermen in India have been involved themselves in traditional marine fishing. In the seventies, fishermen started concentrating on catching shrimp due to high profitable returns on account of its export value. Brackish water shrimp farming was started in a big way during nineties especially in the coastal districts of Andhra Pradesh and Tamil Nadu and also proved to be a highly remunerative venture for the entrepreneurs. Incidentally, in many pockets in the inland states, the subsoil water has become saline or semi saline due to some or the other reasons with the salinity generally ranging between 5 parts per thousand (ppt) and 15 ppt. These pockets are prevalent in northern states like Rajasthan, Western Uttar Pradesh, many parts of Punjab, Haryana and even elsewhere. Getting encouraged by the successful pilots conducted by the CIFE, Rohtak centre, some of the saline affected farm land in district Rohtak in Haryana were converted by the farmers for culturing tiger prawn i.e. Penaeus monodon.

However, in view of non availability of quality tiger prawn seeds, the farmers have now gradually switched over and initiated cultivation of the white legged shrimp i.e. Litopenaeus vannamei. The saline lands, which are otherwise unsuited for any other agricultural activity can be effectively utilised for culturing brackish water shrimp viz. the popular White leg shrimp, Pacific white shrimp or Vannamei shrimp. Incidentally, large patches of land are available in the aforementioned states where saline soils exists along with saline ground water. Saline or semi saline waters can no longer be used for irrigation or drinking.

It is toxic to plants, and high sodium levels in them makes the soil hard, compact and reduces the ability of the soils to absorb water. Irrigation water becomes toxic to most plants at concentrations above 1.50 ppt. salinity may not be dangerous to humans, but water becomes non-potable for human consumption beyond 0.50 ppt.Being relatively expensive and to some extent risky and skilful venture, as at present, small farmers and marginal farmers have not come forward to adopt the activity in a large way. Being capital intensive activity, bigger farmers, who have relatively more risk bearing capacity, have initiated the shrimp farming activity in these saline lands.

Discussions with experts in the field reveal that approximately 2.5 to 3.0 million hectare area in the northern Indian plain region suffers from the problems of higher salinity. This is not only alarming but has also resulted in rendering these areas unsuited for any other productive agricultural use. Using a conservative estimate, even if 20% of the existing saline wastelands are utilized for its cultivation, the country will be in a position to produce nearly 2.0 million metric tons shrimp or Vannamei per annum. Being a high valued food product, the country would thus be able to produce a high valued protein and would also earn huge foreign exchange besides generating tremendous employment in the farm sector.

Farmers in these areas are practicing Vannamei shrimp farming in pond usually measuring one to two acres. Wherever there is high amount of seepage, the farmers use polythene linings in the pond bottom so that water could be retained. The shrimp ponds are scientifically constructed facilitating easy drainage and drying after each harvest. Important management aspects like maintenance of water supply, treatment of organic and inorganic fertilizers, maintenance of water parameters, adequate seed stocking, feed management using formulated feeds and proper aeration are being scrupulously followed.

Salt deposits seen in vast tracts in Mathura district rendering the land unsuited for other agricultural use

The average production of shrimps in the saline shrimp farms of northern India is approximately 3,500 kgs/acre/crop. Many of the farmers presently prefer cultivation of only one crop in a year. This is due to the fact that the shrimps are not able to tolerate cold temperatures during the winters (November to March). However, efforts are being made by the entrepreneurs to take two crops of shrimps in a year in near future. The average farm gate price being fetched by the farmers when sold to the exporters and processors ranges between Rs.350/- and Rs.400/- per kg. Thus, by and large the activity is economically quite viable keeping in mind the fact that it is being carried out in areas which otherwise unsuitable for any other agricultural purposes.

Feedback received from various stake holders reveal that operational cost for one crop for one acre Vannamei shrimp farming in north India may be around Rs.7.0 lakh. As against this, the total income per acre per crop works out to be approximately Rs.11 to Rs.12 lakh. Gradually the operational cost comes down whereas, the income per crop increases, thus resulting in enhanced income of farmers. Such cost model may be replicable in all the northern states of the country namely the western Uttar Pradesh, Rajasthan, Punjab, Haryana and even in the rural areas of the National Capital Region.

Despite the farmers doing well, some of the constraints coming in way of the success of the activity are timely availability of quality inputs like the shrimp seeds (which are to be transported from coastal states), formulated feed and probiotics etc. Besides these, other important aspect is the fluctuating market for the shrimps. Availability of credit and insurance support, besides, proactive role of the nodal

departments in providing guidance and training to the entrepreneurs will also go a long way in the success of the shrimp farming in the ensuing future. Farmers taking up shrimp farming are also being encouraged by extending them subsidy support under the Government of India's "Blue Revolution Scheme". Good

amount of subsidy support at the rate of 40% for farmers belonging to the general category (60% support for SC/ST/Women farmers) is extended under the scheme. Perceiving some amount of risk in the activity, bankers as of now are not very keen in supporting the activity.

There is however a need for conducting specialized intensive training on shrimp farming for the existing as well as prospective farmers. More soil/water testing laboratory also need to be established in potential districts as theentire shrimp farming depends upon the stability of the water parameters like dissolve oxygen content, pH, ammonia, nitrates, nitrites, alkalinity, hardness and elements like potassium, calcium, magnesium etc. Further, establishment of processing/storage facilities for shrimp farming along with other meat products in potential districts will go a long way popularizing the activity as also benefitting the farmers.

The important role played by the Regional Centre of the Central Institute of Fisheries Education (ICAR) situated at Rohtak, Haryana as also the respective departments of different states have to be appreciated in popularisingtheshrimpcultivationasalsobuilding capacities of the farmers. In fact, the CIFE centre at Rohtak has been instrumental in providing regular extension services to most of the farmers of Haryana, Punjab, Rajasthan and Western UP.

The activity which is immensely popular in the coastal belt of the country has also proved to be an economically viable activity in the saline affected lands of north India.Many shrimp farms on a large scale are have already come up in areas which are not only arid and semi-arid, but, also where the ground water cannot be used for any other purpose due to high salinity. The success of the shrimp farming in north India can be a game changer not only for the farmers but also for the country as whole as shrimp is not only a high value commodity but also has a high export value. Besides other benefits, shrimp farming in saline wastelands of northern India has immense potential for generating lot of employment opportunities on a long term basis.

Salt deposits seen in vast tracts in Mathura district rendering the land unsuited for other agricultural use

Farmers found using HDPE lining in the ponds with high seepage

Paddle wheel aerators used for aeration and increasing oxygen level in the pond

Disclaimer

The views expressed by the author in the paper is his own and not that of their organization. The write-up is based on information & data procured from various sources as also as per the discussions held with the practicing farmers and officials of the nodal departments.

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